

**Testimony of
Rich Sorkin
Chief Executive Officer of Jupiter Intelligence**

**Before the Subcommittee on Environment of the
House Committee on Science, Space, and Technology
Hearing: “The Future of Forecasting: Building a Stronger U.S. Weather Enterprise”**

May 16, 2019

Chairwoman Fletcher, Ranking Member Marshall, and Members of the Subcommittee, I am Rich Sorkin, CEO of Jupiter Intelligence. Jupiter predicts risks from weather and climate change. I appreciate the opportunity to testify before you today.

Executive summary

Jupiter predicts risks from weather and climate change.

We understand the Committee is broadly interested in the Weather Enterprise, leadership in forecasting, and the role of the private sector, against the backdrop of increasingly severe weather due to climate change.

We would like to emphasize three core points:

First, broad sectors of U.S. society are increasingly concerned about the growing risks to life, well-being, and property caused by climate change. The federal government should, among other things, do more on preparedness, especially in programs related to infrastructure investment and the Department of Defense.

Events such as Hurricane Katrina, Superstorm Sandy, Hurricane Harvey, Midwest flooding, and the California wildfires dramatically illustrate the need for improvement in planning for, predicting, communicating, and reducing the risks of impacts from extreme weather that touch nearly every urban and rural area of the nation.

Costs for emergency response and disaster recovery, especially from FEMA, are increasing much faster than GDP or government revenues.

Recently, the Air Force requested that Congress allocate \$4.9 billion for repairs at just two bases — Tyndall in Florida and Offutt in Nebraska — from damages due to severe weather. And this is just the tip of the iceberg.

For many years, climate change was viewed as a problem for future generations. But recent events demonstrate that the impacts of climate change are upon us and getting worse.

And the risks of climate change are resonating in corporate boardrooms. Last month, the Governor of the Bank of England stated: “The majority of banks...are already seriously considering the financial risks that arise from climate change. We expect regulated firms to manage these risks strategically.”

Second, while NOAA and the National Weather Service do an excellent job of forecasting, they could do even better by using technologies widely adopted in the private sector, particularly Artificial Intelligence (or AI) and Cloud Computing. Jupiter, for example, is seeing enormous acceleration in transitioning research to operations through the use of cloud computing. It assists in global collaboration both inside the company and with our university partners, and in rapid prototyping and accelerated performance testing.

Another technology, AI, is delivering significant benefits to Jupiter in the spatial and temporal resolution of our predictions, the speed of developing new services, and reductions in costs for computing.

It is also worth highlighting that China is making enormous progress in AI across their entire society. We should be much more aggressive in ensuring that we are not leapfrogged by China, both in the Weather Enterprise and more generally.

The Earth Prediction Innovation Center, or EPIC, is an excellent first step in NOAA adopting AI and cloud computing.

Third, the path to continued and renewed U.S. leadership across the Weather Enterprise depends upon stronger collaboration between the three sectors of the Enterprise.

A vibrant private sector is emerging for solutions to help customers understand, plan for, and mitigate the impacts of severe weather, especially as they continue to worsen.

Investors have deployed billions of dollars in satellites, other observations, and analytics including work like ours and will continue to invest more, especially if we can get the collaborative relationship right, with the federal government focusing on the core modeling that the private sector can build upon.

At Jupiter, we have followed a collaborative philosophy from the beginning, working with both the federal government and university partners.

Going forward, we recommend enhanced investment in NOAA’s capabilities to produce better weather forecasts, near-term and seasonal, as well as expanded observations to support the production of actionable climate risk services. While NOAA’s role in saving lives and property is paramount, the private sector can supply hyper-local climate information to municipalities and the private sector.

We also recommend easing the way for public-private collaborations as well as improved mechanisms for allowing pilot projects with NOAA, some of which could provide favorable returns on investment for the U.S. Government and its agencies.

The following written statement includes more detail on these and related issues.

Background

Weather and climate have a powerful impact on the health, safety, security, and prosperity of the United States and the world. During the 20th century, the U.S. Weather Enterprise, including federal agencies, academia, and private industry, led the world in providing information that drove enormous improvements in agricultural productivity, transportation safety, warnings for extreme events such as tornadoes and hurricanes, the everyday quality of citizen's lives, and a broad range of other social and economic benefits. Advances in the U.S. Weather Enterprise also informed key Department of Defense strategic basing and deployment decisions.

Historically, the public, private, and academic sectors have worked together to provide forecast products of unequalled accuracy, specificity, and availability. As the need for better, more precise weather and climate information expands, the enterprise cannot fully meet the challenges of the 21st century without deeper collaboration. Innovation and advances in technology, from AI to cloud computing, are occurring more rapidly in the private sector. Many aspects of forecast accuracy have been significantly enhanced and produced life-saving improvements in the lead time for warnings of severe weather, and in improved track forecasts of hurricanes, as well as in the timing and spatial extent of winter weather.

However, the potent impact of events such as Hurricane Katrina, Superstorm Sandy, Hurricane Harvey, Midwest flooding, and the stunning fires in California and the west over the last several years dramatically illustrates the need for improvement in planning for, predicting, and communicating the risks of impacts of extreme weather that touch nearly every urban and rural area of the nation. Costs for emergency response and disaster recovery, especially from FEMA, are increasing much faster than GDP or government revenues. Between FY 2013 and FY 2018, FEMA Disaster Relief Fund spending grew from \$11.1 billion to \$26.4 billion, 140% growth, outpacing U.S. GDP growth from \$16.7 trillion to \$20.5 trillion, 23% growth during the same time frame.¹

The Air Force alone recently requested that Congress allocate \$4.9 billion for repairs at just two bases — Tyndall in Florida as a result of Hurricane Michael, and Offutt in Nebraska on account of Midwest flooding. And this is just the tip of the iceberg.

¹ FEMA, *Disaster Relief Monthly Report*, updated May 8, 2019. <https://www.fema.gov/media-library/assets/documents/31789>

Jupiter Intelligence

Jupiter is a private sector company addressing many of these challenges. Our customers own, insure, lend to, and govern roughly \$1 trillion in physical and financial assets, and use Jupiter's products for a broad range of risk-oriented decisions. Jupiter's customers include some of the world's largest insurance companies and mortgage firms, power providers, resource companies and ports, large cities, and state Departments of Environmental Protection. One customer is funded by the U.S. Department of Housing and Urban Development (HUD) Rebuild by Design Program. We increasingly operate all over the world, including having offices in New York, California, and Colorado, and provide our risk prediction services in Texas, Florida, New York and other states and countries. Today, we provide projections of future flooding, wind, and extreme heat tailored to the decision-making processes of our customers. Later this year, we will add fire. Jupiter's hyper-local probabilistic estimates of hazards are on the time scales that matter to our customers, hours or decades, and go far beyond what is available from any government or university. Our success is based on using dynamic modeling combined with Artificial Intelligence (AI), cloud computing, and risk analytics, and designing a great, easy-to-use customer (user) experience. The Company's scientists test their forecasts against the best available observations — to see, for instance, how well they predict flooding from major storms using reports of calls to emergency management.

If a customer wants a full picture of flooding risk, for example, they need expertise in weather, and also in climate, hydrology, engineering, risk, and running complex models on the latest computer hardware. Within the public sector and the scientific community, teams focusing on these very different areas do not necessarily coordinate sufficiently closely, or at least not to the degree which occurs at Jupiter.

Jupiter's predictive tools, with simple interactive visuals that look much like Google Maps, allow our customers to zoom down to the city block or asset level to get a better sense of the potential risks they face from storms, heat waves, wildfires, or other climate-change effects in the coming decades.

WIRED recently wrote: "If you run a business, or maintain a city, or plan power plants or highways or bridges, you'd like to know how bad things are, and how bad they're going to get. That's what Jupiter ... sells. Jupiter explicitly incorporates climate change into its models for catastroph[ic] risk, both proprietary and public, and then offers that knowledge to the kind of people who might lose money when the floods, fires, storms, and heat waves really kick in."

Jupiter has a strong interest in a vibrant Weather Enterprise

Jupiter uses weather predictions and climate models as inputs to these risk predictions. To create flood maps, Jupiter uses public data, including satellite-based observations of rainfall and gage measurements of waves and storm surge. We integrate this with information from other sources, including how changes in the urban landscape affect how water flows through cities. We harness recent advances in cloud-based elastic computing to combine all the data sources, models, and analytics in a single solution.

Jupiter relies on NOAA and other federally funded efforts to supply global climate models and their projections, as well as critical observations, including the ocean buoys and river gages, while working with customers in ways that, while complementary, are beyond the mandate of the federal government.

The frequency and severity of extreme weather events are increasing due to climate change

As the U.S. National Climate Assessment (NCA) makes clear, many of the extreme impacts we are seeing are driven by the changes that have already occurred in the global climate. U.S. average temperature has increased by 1.3°F to 1.9°F since record-keeping began in 1895; most of this increase has occurred since about 1970. Since 1950, the number of heavy precipitation events for the U.S. has increased by 40 percent.²

For a long time, the issue of climate change and its impacts seemed to be something to be addressed in the distant future, a problem for our children and grandchildren. No longer. Events of recent years demonstrate that the impacts of climate change are upon us. And they are getting worse.

Not surprisingly, the risks of climate change, including the risks of liability, are resonating in corporate boardrooms, and the private sector is taking on new leadership in addressing the severe and growing impacts of severe weather events. Shareholders are increasingly demanding it. Banks are starting to pay attention, as Bank of England Governor Mark Carney recently stated: “We will expect our regulated firms to anticipate and manage the risks ... “The majority of banks recognise this and are already seriously considering the financial risks that arise from climate change. We expect regulated firms to manage these risks strategically.”³

²USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, Volume II [D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.

³The Bank of England, *PRA Review Finds That 70% of Banks Recognise That Climate Change Poses Financial Risk*, 26 September 2018.

Current challenges have broad impacts, including for national security

The intensifying impacts of climate change poses significant challenges for our society. The truth is, we live in a world designed for an environment that no longer exists. The public and private sectors must design, implement, and operate assets based on realistic expectations of future weather and climate conditions. Otherwise, critical infrastructure such as hospitals, power plants, and roads may be unavailable at times when most urgently needed. The public and private sectors must have better warning systems for floods and fires. Look at the consequences of extreme events in just two places — the destruction to Tyndall Air Force Base in Florida caused by Hurricane Michael, and the ravages of the California fires that killed at least 88 people and wiped out PG&E shareholders. Both the insurance industry and NOAA estimated that the economic costs of severe weather events in the U.S. were nearly \$1 trillion in the last ten years. Those costs are growing significantly faster than GDP,⁴ as in the case of the 2013-2018 toll for FEMA disaster recovery and emergency services cited earlier.

Asset owners, planners, developers, investors, and government agencies are increasingly recognizing the need to incorporate climate impact data into risk modeling for specific assets. Catastrophic risk modeling most often projects the future based on past statistics with the assumption that the climate is not changing. This approach is flawed in today's dynamic environment, which is continually shaped by changes to built and natural landscapes. Similarly, climate panels at the international, national, state, and metropolitan levels use inconsistent methodologies, validation approaches, and metrics that make it nearly impossible for the private sector to use them without extensive custom work.

Today's decision-makers need data that reflect ongoing change and provide consistent approaches to quantifying physical risk in a changing climate. With the right information, they can make more informed decisions for site selection and design, critical infrastructure planning, equipment ratings, capital investment and portfolio planning, insurance, alternative investment decisions, zoning, and building code development, among other things. The right decisions improve safety and reduce risks to critical infrastructure and business operations.

Climate change poses an especially noteworthy threat to our military readiness due to its effect on frequency and intensity of extreme weather events and sea level rise. This has implications for our ability to project power and influence around the world, and can constrain our capacity to effectively advance our interests abroad.

⁴ NOAA, National Centers for Environmental Information.

<https://www.ncdc.noaa.gov/billions/summary-stats>

<https://www.ncei.noaa.gov/news/calculating-cost-weather-and-climate-disasters>

Military leaders have concluded that climate change now contributes to unprecedented security threats for the United States – and the world. In 2017, Secretary of Defense James Mattis stated that the effects of a changing climate “impact our security situation,” and that “we are prepared to address the effects of a changing climate on our threat assessments, resources, and readiness.” In 2016, the Climate Security Consensus Project stated that “the effects of climate change present a strategically significant risk to U.S. national security.” In 2018, the National Defense Authorization Act stated that “climate change presents a direct threat to national security.” During this Administration alone, at least 23 senior military leaders have publicly expressed serious concerns about the security threats of a changing climate.

Research supported by USAID, and published in September of last year, further demonstrates the effects of climate change on state fragility around the world. In written testimony on the Worldwide Threat Assessment in January 2019, the Director of National Intelligence, Daniel Coats, emphasized that the United States will have to manage the negative effects of a changing climate. The Director of National Intelligence has issued such concerns in 11 straight Worldwide Threat Assessments.

The Weather Enterprise cannot cure climate change. But it must diagnose the problem and treat the ever-worsening symptoms. As storms, fires, floods, heat waves, and other weather events and impacts continue to become more frequent and severe, especially in larger and denser concentrations of people and assets, the country needs to better plan for and respond to these events.

State of the U.S. Weather Enterprise: public, private and academic partners

As the Committee well knows, the federal agency members of the U.S. Weather Enterprise are responsible for much of the advances in science and technology that lead to increasing skill in weather forecasting. For example, investments in technology led to the new generation of weather satellites that increase warning times, and provide unprecedented data for ingest to weather forecasting models. Investments in basic science led to increased understanding of complex interactions between a hurricane and its environment to increase skill in hurricane track forecasting. The U.S. Weather and Climate Enterprise is the most active and productive enterprise in the world, providing innovation and products to the U.S.

And yet we are seeing governments and private sector entities demanding more actionable information on weather (and climate) risks. The *New York Times* wrote “[D]etailed information about the city’s climate risks proved surprisingly hard to find ... Scientific reports on global warming, such as the [National Climate Assessment](#), can tell you that heavy rainstorms are

expected to increase in the Southeast ... Federal flood maps are based on historical data, and [won't tell you how sea-level rise could exacerbate flooding](#) in the years ahead.”⁵

As a result, the public and private sectors must continue to evolve. Fortunately, the technology is here today to make this happen. As the needs for weather and climate information expand, as well as innovations both from technological observations and analytical approaches to producing products, the natural roles for the public, private and academic sectors will need to continue to evolve. For instance, in the past, all weather forecasts came from the National Weather Service (NWS), then increasingly over the radio or television; now, forecasts often come to us on our phones and from commercial weather providers. Coincident with these changes, our forecasts are more targeted, accurate and useful than ever before.

The private sector provides products with localized detail designed to customers' specifications while these products are built on foundational models and observations that NOAA currently provides. Thus, public-private partnerships are crucial.

Private sector in weather products and services

Companies like Jupiter rely on NOAA to provide state-of-the-art weather prediction and consistent, long-term observations, and rely on the academic sector to continue with world class research which is the foundation of our products. This collaborative relationship is at the heart of the American Weather and Climate Enterprise.

While the conversations as to how NOAA and the private sector should interact on issues of weather and climate are evolving, many more questions need to be addressed, including critical observations, climate modeling priorities, and appropriate roles for hyper-local information.

These hyper-local products, for the most part, are best supplied by private sector entities including Jupiter. Addressing these needs may require NOAA to produce different observations, or share in the development of shorter-term climate information. For example, funding from NOAA and the Departments of Defense and Transportation supported university development of prototypes for short-term flood prediction by the team now at Jupiter. These are currently used in New York by the Port Authority, Transit Agency, city, and state to anticipate impacts one hour to five days ahead of storms. Yet, large commercial entities prefer to buy these services from private companies with service level commitments, regular upgrade plans and modern user interfaces.

In particular, risk analytics are often best provided by the private sector which has dramatically outpaced the public sector in probabilistic analytics tailored for different sectors — consumers,

⁵Plumer, Brad, “Will Land be Underwater in 20 Years? Figuring It Out Could be Lucrative,” *The New York Times*, February 23, 2018.

<https://www.nytimes.com/2018/02/23/climate/mapping-future-climate-risk.html>

insurance, banking, infrastructure, tourism, real estate etc. We believe the federal government should defer to the private sector in this area, except as it relates to public safety and national security, where the public sector can also leverage private sector investments across the planet and multiple industries.

In data analytics, the private sector is increasingly moving to a model of buying data and analytics rather than owning the infrastructure to create and deliver the data and analytics. It is worth exploring how the Federal government can leverage similar models for observations for faster deployments and lower taxpayer expense, while maintaining U.S. companies' access to observations.

And, just as the weather has changed, so too has the technology landscape. The private sector now accounts for a very large percentage of basic R&D. Supercomputing has not only evolved from monolithic systems to distributed parallel servers but increasingly is performed in the cloud at Amazon, Microsoft and Google. New, nimble private-sector space companies like SpaceX, Rocket, Planet, Capella, and Spire are designing, launching, and running satellites, and AI-based predictions are seeping into every sector of the economy. Increasingly Americans get their information from their phones and social media, not TV and radio. In nearly every case, the private sector is leading the adoption of these new technologies, driven by brutal competition for profits in industries like advertising, commerce, finance, and natural resources.

Similarly, the business community is increasingly attentive to the need to plan for and respond to weather and climate risks, working with but not waiting for the U.S. public sector. For example, the power sector is gradually starting to plan for heat stress on industrial infrastructure and doing a better job planning for ongoing reliability as billions of dollars of equipment becomes less reliable and needs to be replaced sooner.

Steps to foster U.S. leadership in weather forecasting, modeling and communication

The weather forecasting capability of the Federal government today is overwhelmingly based in dynamic modeling to simulate the character of the atmosphere to predict its evolution over a variety of space and time scales. These models require vast amount of observations from a multitude of national, international, and private sources. Additionally, the models run on large, government-owned supercomputers.

The Weather Enterprise needs to re-examine how observations, models and data-sharing should change in the future. And the needs of the private sector for climate information requires a similar examination or re-examination. The National Academy stands poised to conduct this type of examination.

While the private sector and local municipalities appreciate NOAA and other federal products, and the substantial contributions to this field, these users are seeking tailored products that can address their needs at a local level. Estimates of risks to specific assets are best provided by

the private sector. As *The New York Times* wrote, current public sector models and forecasts: “won’t tell you whether specific roads leading to a given warehouse might be unusable during ... storms.” Private sector entities, including Jupiter, are ready to fill this gap, particularly because the government does not offer comparable services free of charge, and is not expected to do so.

Operational modeling is the core of the Weather Enterprise and it is critically important that the U.S. be a global leader in this area. I largely defer to Dr. Jacobs and Dr. Uccellini on the steps required to accelerate the progress in this area, with two suggestions:

AI and China

AI is delivering significant benefits to Jupiter in the spatial and temporal resolution of our predictions, speed of developing new services, and reductions in costs for computing.

China, our number one geopolitical rival, is making enormous progress in AI across their entire society. While this issue is certainly much broader than the Weather Enterprise, even in the Weather Enterprise, the federal government should be much more aggressive in ensuring that the United States is not leapfrogged by developments in China.

Cloud computing

Jupiter runs its services in the cloud and our team have been pioneers in this area for a decade.

Cloud computing is an excellent option for prototyping scientific advancements; assessing the relative performance of different approaches and data sources; beginning to develop operational capabilities in advance of wide-scale implementation of cloud computing for hourly forecasts; and providing elastic resources when the forecast really matters and in data production workloads aimed at climate impacts.

Many weather forecasting problems, such as tropical cyclones or convective weather outbreaks, lend themselves to elastic computing. Heavy computing is less critical when those types of events are not expected to occur in a given state or region. But when weather threats arise, computer power can be quickly spun up and dedicated to providing the highest resolution and fidelity forecasts possible.

Jupiter’s climate products leverage the cloud by using up to 100 thousand processors at a time to gain massive probabilistic data sets for our analytics. Those can be quickly updated when new science or models are available, on a pace of quarterly to biannually rather than every day.

Cloud computing **should** rapidly become an integral part of the U.S. Weather Enterprise, including for predictions that are not yet operational, non-core or intermittent.

The scale and complexity of the National Weather Service are such that it is probably years away from moving operational weather forecasts to the cloud because making this transition at scale is difficult. Scaling existing operational weather systems on the cloud is beyond Jupiter's current scope of business and NOAA should consider turning to other private sector companies, such as Microsoft, Amazon or Goldman Sachs to identify best practices in this area.

Accelerating research to operations and the role of the private sector

At Jupiter we have seen dramatic acceleration in moving science from the research to operations, largely enabled by cloud computing. In one case, the Jupiter scientists reported that running a new model in the cloud took them a day, versus what previously took months due to dependency on scarce internal information technology (IT) resources at universities and government laboratories. On an experimental basis, not-yet-mature research models can be run in the cloud and integrated as components with other already operationally mature models to assess the integration of models and impact on system-wide performance and skill.

The cloud is also well-suited to collaboration among people and across the planet. When operational environments can be replicated in the cloud, it provides immediate access among collaborators and contributors in a way not possible on dedicated machines behind firewalls. Cloud environments can be made every bit as secure as any dedicated machine that is connected to the internet.

Next steps to develop U.S. leadership in weather modeling and forecasting

Extreme and high-impact events will become ever more important threats to the U.S. in the coming years. Currently, it can be argued that private and public investments in science and technology related to understanding and predicting extreme events are far below what is needed to properly address the risks. Given adequate support, the sectors which comprise the U.S. Weather Enterprise can and will address these threats to the benefit and protection of the nation's infrastructure, society, and people. Three sets of actions can help create a more resilient future that includes improved forecasts of extreme and high-impact events on time scales that range from hours to seasons and beyond. The actions should focus on improved observing systems; improved science and forecast systems; and improved delivery of forecast information. Specifically:

- 1) Enhanced investment in basic science and modeling to increase understanding and simulation of extreme and high-impact events to feed NOAA's capabilities to produce weather forecasts with increased skill in both near-term and seasonal forecasts. Specific actions to support this include:

- a) Greater collaboration between public-private and academic agents, such as proposed by the Earth Prediction Innovation Center.⁶
 - b) Increased ease in allowing for public-private collaborations, allowing private sector innovation to leverage and enhance government investments.
 - c) Improved mechanisms for allowing and enabling pilot projects within NOAA to evolve into established programs, and to be deployed when pilots show value to the science and nation.
- 2) Expanded observations from remotely sensed and *in situ* systems for NOAA to support the production of actionable weather and climate risk services for the protection of life and property, and assessment of risk.
- a) Continued, and in some areas enhanced, technology advances to bolster aging satellite systems and ocean buoy systems that will allow companies such as Jupiter to continue to serve its customers with state-of-the-art, actionable information.
 - b) Expedited testing and expansion of new technologies for *in situ* observing systems of the most important aspects of severe weather, including UAS (unmanned aerial surveillance), private satellites, and new forms of citizen science.
- 3) National Academies
- a) Utilize the National Academy to identify the national needs and capabilities to achieve and maintain a capability that provides the nation with the most detailed, timely, and accurate information for the protection of life and property, and allows for economic prosperity.
 - b) Mandate a decadal-survey approach to ensure that the Academy survey of needs and capabilities is current and prioritized.

Next steps to encourage collaboration between the three sectors

- 1) Increased opportunities and collaboration in public-private collectives to allow efficient, timely, and expanding delivery of weather and climate information, especially on issues of extreme weather and climate.
- 2) Exploration of the role of the private sector in supplying key forecasts — including harbor forecasts — to NOAA, improving efficiencies and accuracies because of the innovation private sector can offer.
- 3) Support for new and existing pathways to collaboration between public and private entities enabling a highly favorable return on investment for the U.S. Government and its agencies.

⁶ NOAA, *NOAA and NCAR Partner on New, State-of-the-Art Modeling Framework*, February 7, 2019. <https://www.noaa.gov/media-release/noaa-and-ncar-partner-on-new-state-of-art-us-modeling-framework>

- 4) Encouragement for NOAA to adopt and increase usage of funding mechanisms that accelerate Research to Operations using Other Transaction Authority (OTA) and similar contracts.

Silicon Valley and other technology focused regions across the nation deploy large sums of venture capital and investment dollars for the purposes of developing innovative and compelling technologies that have applications and utility in the public sector. Pathways such as the Congressionally approved OTA and Small Business Innovation Research (SBIR) vehicles allow for private-sector companies to move at the speed needed to leverage private capital sources. Success on these pilot and contract vehicles is a boon to both private industry, which gains a validated revenue source from the government, and to the public sector, which leverages substantial amounts of research and development money with none of the risk of undertaking privately funded investments internally.

Closing statement

As the weather and climate enterprise goes forward, we at Jupiter want to be clear we rely on and value what NOAA contributes to observing and modeling the Earth System. A continued commitment from the NWS, NOAA, DOE, and other federal entities to provide open access to model output and observational data is critical to enabling the private sector to do what it does best: provide consumable and actionable information to broad economic sectors. We look forward to continuing the conversation and contributing to the decisions which will help shape the Weather and Climate Enterprise of the future, whether this be a set of conversations organized by Department of Commerce or by the National Academies. We understand many of the needs of the private community with respect to risk and climate information and can be helpful in identifying new roles for the public, private, and academic sectors.

Jupiter and other innovative technology companies can offer tremendous additional services to the United States with significant return on investment to the U.S. economy. The innovation that the private sector has demonstrated in technology, efficiencies, and advanced analytical techniques has not yet been fully applied to the weather and climate communities. Enhanced and thoughtful collaborations between the public and private sectors are likely to allow for unprecedented advances that will help secure the infrastructure, economy and people of the United States. Jupiter looks forward to Congressional support of these public private collaborations to secure America's future.

Rich Sorkin is the Chairman, CEO and cofounder of Jupiter Intelligence, based in Silicon Valley. Jupiter provides data analysis through predictive modeling to help governments, organizations and society manage risks from climate change, natural disasters, and sea level rise. Led by veterans of Fortune 100 companies, machine learning pioneers, a Nobel Prize winner, and scientists from NOAA and the National Science Foundation, the firm offers services to predict weather risks from one hour to 50+ years in the future.

In his three-decade-long career as a serial entrepreneur, executive, advisor, board member and investor, he has led breakthrough companies in numerous industries. Sorkin focuses on commercializing transformative technologies, with a significant concentration on financial services, energy, media, politics, and the environment. A founder of multiple startups, his companies have pioneered the use of satellite data and scalable cloud computing to predict weather events for commodity traders and applied analytics to detect identity theft.

Sorkin is the former Chairman and Chief Executive Officer of Zip2, an Internet 1.0 company best known for analytics and visualization of geospatial data. He served as president of Kaggle prior to its acquisition by Google, leading the introduction of big data predictive analytics into the enterprise market and serving as the company's premier industry strategist.

Sorkin began his career as a consultant at Bain & Company. Before moving to Silicon Valley to focus on leading technology companies, he helped initiate research of the supercomputer industry at Goldman Sachs. After graduating business school, he ran the Sound Blaster business at Creative Labs during the time it gained market dominance, growing revenues from under \$100M to close to \$1 billion.

Sorkin is an alumnus of Yale University and Stanford Graduate School of Business, where he was a Lockheed Scholar. He has served as a Board Member at publicly-traded companies, private firms, the Yale University Development Board, and several non-profit organizations.

RICH SORKIN

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Career History

- 2016-current **JUPITER INTELLIGENCE, CEO** San Mateo, CA
- 2015-current **SORKIN ANALYTICS, Managing Director** San Carlos, CA
- Advise numerous startups including ones focused on
 - Satellite and aerial based observations (Capella, Kairos)
 - Oil and gas services (OAG)
 - Anti-money laundering (Merlon)
 - High performance database search, cloud based applications and biometric based security
 - Education (FlexSchool)
 - Special Advisor to Data Collective Venture Capital (DCVC)
- 2012-2014 **KAGGLE, President (initially COO)** San Francisco, CA
- Ran all business functions of globally recognized leader in big data and crowd sourcing
 - Built and managed strategic customer relationships with GE and Shell
 - Drove doubling of revenue for each of 3 years
 - Acquired by Google
- 2009-2011 **ZEUS ANALYTICS, Founder and Chief Executive Officer** San Mateo, CA
- Developed world's first weather forecasting service using cloud infrastructure
 - Focused on use by commodities traders
 - Restarted as Jupiter Intelligence
- 2003-2006 **RES FINANCE, INC., Founder and Chief Executive Officer** San Mateo, CA
- Conceived idea for algorithms to detect and prevent identity theft
 - Raised \$1 million in angel financing to fund development and licensed solution
 - Filed for 4 business process patents
- 1999-present **Advisor to and Director of emerging growth companies, including:**
- Commtouch, NASDAQ listed anti-virus company, *Director and Advisor, 1999-2005*
 - E-Color (acquired by Verisign), internet infrastructure, *Director and Advisor, 1999-2003*
 - When.com (acquired by AOL), internet calendaring, *Advisor, 1999-2000*
 - Additional companies in internet commerce and infrastructure, mobile, *1999-2009*
- 1996-1999 **ZIP2 CORPORATION, Chairman of the Board (1998 to 1999)** Mountain View, CA
- HP (Compaq's AltaVista division) acquired Zip2 for \$307 million in cash in February 1999
 - Responsible for company's key strategic relationships
- President and Chief Executive Officer (1996 to 1998)**
- Created partner-focused business strategy for Zip2, an internet local search startup
 - Established newspaper industry standard with 160 media partnerships
 - Negotiated million dollar partnerships with The New York Times, Knight-Ridder, and Hearst
 - Built management team and grew company from twelve to 150 people
 - Raised \$37 million in equity capital from venture capital firms and media industry partners
 - Grew revenue from 0 in 1996 to \$8 million in 1998 and \$20 million in 1999
 - Oversaw product development organization with one major new product per quarter
 - Consummated the acquisition of Pantheon Systems for approximately \$10 million

- 1993-1996 **CREATIVE TECHNOLOGY, LTD.** Milpitas, CA
Vice President, Audio and Communications Products (1993-1996, promoted from Director)
 - Grew businesses from \$80M to \$800M in 3 years**General Manager, OEM Division (1995-96) and Vice President, Strategy (1994-96)**
 - Peak market capitalization \$1.7 billion
- 1991-1993 **PHOENIX TECHNOLOGIES, LTD, Director, Advanced Technology Group** San Jose, CA
 - Created group responsible for identifying and exploiting new markets for firmware
 - Acquired by Intel
- 1990-1991 **POQET COMPUTER, Senior Product Manager** Sunnyvale, CA
 - Established product marketing department for startup focused on portable computers
 - Acquired by Fujitsu
- 1988-1990 **ASHTON-TATE, Product Manager** Los Gatos, CA
 - Led product planning and product marketing for Macintosh spreadsheet software
 - Acquired by Borland
- Summer
1987 **GOLDMAN, SACHS & CO.** New York, NY
Associate, Equity Research Department (Technology Group)
 - Established coverage of supercomputer industry
- 1984-1986 **BAIN & COMPANY, Associate Consultant** Boston, MA
- Summer
1982 **NATIONAL AERONAUTICS & SPACE ADMINISTRATION** Washington, D.C.
Computer Analyst
 - Supported development of budget for U.S. Space Station
- Education**
- 1988 **STANFORD GRADUATE SCHOOL OF BUSINESS** Stanford, CA
MBA with focus in technology development and marketing
Managed technology consulting team for David Montgomery, Professor of Marketing
- 1984 **YALE COLLEGE** New Haven, CT
BA, *cum laude*, in economics
Research Assistant, Reforming Federal Regulation (Litan & Nordhaus)